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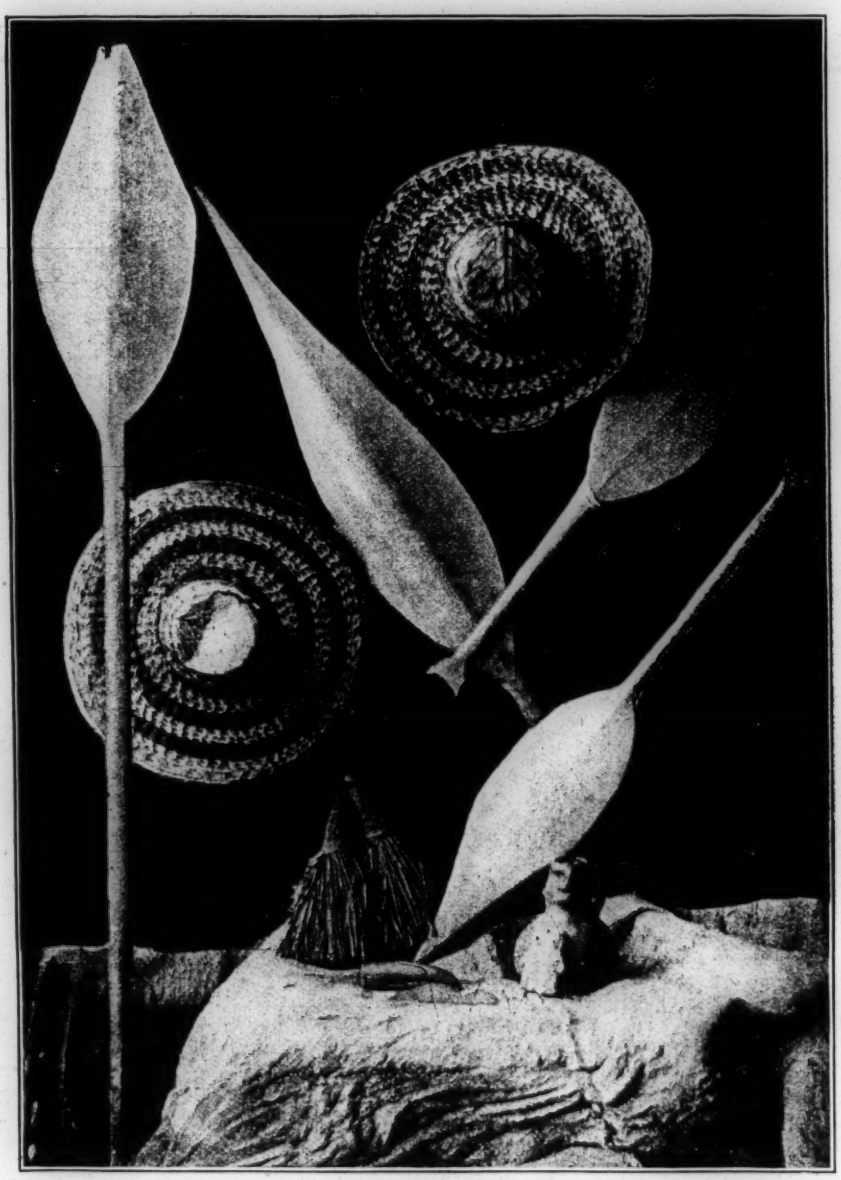


HANDIWORK OF THE CAYAPAS INDIANS, ECUADOR

From an Original Photograph by Mark B. Kerr, C. E.

See page 242.

THE

National Geographic Magazine

VOL. VII JULY, 1896 No. 7

THE WORK OF THE UNITED STATES BOARD ON GEOGRAPHIC NAMES

By HENRY GANNETT,

Chairman of the Board and Chief Geographer of the U. S. Geological Survey and of the Tenth and Eleventh Censuses

This board was originally constituted. in the early part of 1890, as a voluntary association of officers of various departments of the government for the purpose of securing uniformity in the official spelling of geographic names. It was the result, in the main, of the efforts of Dr T. C. Mendenhall, then Superintendent of the U. S. Coast and Geodetic Survey, who was chosen its first chairman. It was given standing and authority by an executive order of September 4, 1890, which reads as follows:

"As it is desirable that uniform usage in regard to geographic nomenclature and orthography obtain throughout the executive departments of the government, and particularly upon the maps and charts issued by the various departments and bureaus, I hereby constitute a Board on Geographic Names and designate the following persons, who have heretofore coöperated for a similar purpose under the authority of the several departments, bureaus, and institutions with which they are connected, as members of said board. . . . To this board shall be referred all unsettled questions concerning geographic names which arise in the departments, and the decisions of the board are to be accepted by these departments as the standard authority in such matters." . . .

The board now consists of representatives of the following departments and bureaus: State, War, and Navy departments, Light-House Board, Coast and Geodetic Survey, Geological Survey, General Land Office, Post Office Department, and Smithsonian Institution.

During the five years or more of its existence the board has held 48 meetings and has decided 2,835 cases. Its *modus operandi* is simple and direct. The cases of disputed nomenclature which reach it are referred at once to an executive committee consisting at present of the representatives of the Geological Survey, Navy Department, and Coast and Geodetic Survey. An investigation of each case is made by this executive committee, which reports it, with recommendations, to the board, which makes a final decision. For such decision a majority of the entire board is necessary. It not infrequently happens, therefore, that it is only by a unanimous vote of those present at a meeting that definite action can be taken.

Geographic names may be broadly distinguished into two classes: those which are established by usage, commonly local usage, and those which are not so established. In regard to the former class, the primary principle which controls the decisions of the board is that local usage ought to prevail. What the people call themselves and what they call the natural features lying within their jurisdiction should, unless there is good reason to the contrary, be the names thereof. That this is just and proper surely goes without saying. In general, every man has a right to insist that other people call him by the name which he selects and accept that spelling of his name which he chooses to adopt. The rights which a man has over his own name, a community has over its own name and over the names of all natural features lying within its jurisdiction. Lest it should appear that I am dwelling too much on this aspect of the case and arguing a self-evident proposition, let me quote from an article recently published in Justus Perthes' Geographische Mittheilungen, which will show that there are men, and men of eminence, too, who do not accept this principle.

"The practical Americans have had since 1890 a Bureau of Geographic Names. . . . The establishment of this Bureau on Geographic Names and its first decisions were referred to in our last report. We gave a hearty greeting to the new creation, and added to the greeting a few suggestions; but these have not been considered. Nay, more, the later decisions of the board, about 700 in number, relating to geographic names at home and abroad, correspond still less to the most reasonable expectations. We miss the principle that the original form of the name, the meaning and etymology of the name, the motive for naming, is to be considered, and considered *first and foremost*. We miss the scientific spirit, which, instead of cleaving to the form, unlocks the intrinsic meaning, and accordingly we miss in the works of a government board of names all evidence of acquaintance with toponymic literature."

Summarizing a discussion which took place before the National Geographic Society on the subject of geographic names, the same author says:

"Only the last named among the four speakers has a word to say in behalf of the original forms of the nomenclature introduced by discovery and explorers, or received from the Indians; but his championship is timid and surrounded by wide reservation. Nowhere do we find the principle laid down that the original forms of names, especially Indian names, which are so true to life, are to be preserved as much as possible. A board of names has no easy task. It has not merely to give 'decisions,' but also to base these decisions on thorough study, and to inform the public, so far as necessary, of the grounds on which they are made. We wish to know from what variations the form selected has been picked out; and this statement will serve to show the amount of knowledge of literature possessed and the scientific principle followed, and will itself win for the decision the confidence of the interested circles. Only this method turns out solid work; any other procedure merely replaces private caprice by official caprice. This official caprice is able to turn a 'Golfo Triste' (sad bay) into a 'Gulf of Triste,' thus manufacturing a personal name or place name, Triste, after which the bay must have been named. It is well known that this feature is the arm of the sea between the Orinoco and Trinidad, to which the Dragon's gorge forms the northern entrance, a passage which was deserted and feared even in the time of Columbus, because ships, driving with spread sails under brisk west wind against the mighty current of the Orinoco, are exposed to danger. The above-mentioned decision of the board of names has masked the physical fact and formally falsified an expressive geographic name."

With regard to this case, it may be stated that the board has made no decision whatever. It has not come before it.

"In the United States and elsewhere there are undoubtedly an infinity of names and places of obscure origin, and for which a decision has to be made without giving reasons. Be it so. We recognize the necessity where it exists; but just as positively must we demand that the decision be made on scientific grounds whenever possible."

Dr Egli, the writer of this article, is well known as one of the leading geographers of Europe and one who has given much attention to this subject of geographic names. It seems to me clear, however, and in that view I know that I share the opinion of the other members of the board, that he is radically wrong in the views he here presents. He states the exact fact when he says that "We miss the principle that the original form of the name, the meaning, the etymology of the name, the motive for naming, is to be considered, and considered *first* and *foremost*."

It is true that the board attaches little importance to these

matters. On the contrary, its fundamental principle, as before stated—a principle which has controlled many hundreds of its decisions—is that local usage, the prevalent usage of the people living in the neighborhood, should be followed. By this it is not meant that local usage has absolutely controlled in all cases. Departures have been made whenever, for other reasons, such a course seemed wise, but this principle has controlled the decisions of the board in nine cases out of ten. I have already touched on its validity. Concerning its expediency, I may say that unless the decisions of the board are adopted by the people and generally followed its work will be a failure. It was constituted not to restore corrupted forms to so-called pure forms, but to secure uniformity of usage. There is not force enough in any government, at least not enough in the government of the United States, to make the people do what they do not wish to do. To fly in the face of the community is like attempting to dam up a river and force it to flow up hill.

To adopt as the "first and foremost" principle the one formulated by Dr Egli, that the original forms of names be restored, would lead to some startling results, results which he surely does not fully appreciate. Geographic names in the United States have been modified, changed, distorted, corrupted, if you will, to an astonishing extent. To throw aside these corrupted but well established names and replace them by old and forgotten forms would involve wholesale changes, such as would find no following among the people of the United States. The name which was accepted fifty or a hundred years ago is not the name in use at present; today the people accept something else.

An example of corruption is seen in the name Bobruly, applied to a creek in Missouri. The original will. of course, be recognized as Bois Brulé. Again, Rum river, Wisconsin, was originally the St. Esprit, which, translated, became Spirit river, and thence, by some pundit, rendered in its present form. For a whole century Wisconsin was spelled Ouisconsing. Would there be any right or propriety in reverting to that spelling and requiring the citizens of the Badger State to adopt it in place of the present form? Shall we attempt to revive the name Illinois or Illinovacks in place of Michigan for one of the Great Lakes, Ouabash for Wabash, and apply it to the Ohio river, or call it La Belle Riviere? Should we substitute Kichi Gummi, Grand Lac, Tracy, Condé, or Algona for Lake Superior, and Ihankton for Yankton? Shall we call the Mississippi the St. Francis, the

Colbert, the Conception, or the St. Louis; shall we change Missouri into Missouries or St. Phillip, and Iowa into Ioway?

We might go on and quote thousands of names that have been changed to a greater or less extent, but these few will suffice to illustrate the matter. Examination of old maps of the United States shows that a majority of the geographic names now in use have been changed since they were first applied; consequently it would be utterly impracticable to ignore the forms to which the people are now accustomed, even if there were no impropriety in so doing. In short, it is impossible, even were it desirable, to restore the original forms of names.

The principle above enunciated is a far-reaching one, and it will be well, before entering upon a discussion of the exceptions which the board makes to it, to follow it and see to what it leads us. The names of many features in foreign countries have from time out of mind been known to English-speaking people by names other than those applied by their inhabitants. The Germans call their country Deutschland, the Italians call theirs Italia, the Spaniards España. The citizens of certain places in Italia call their cities Livorno, Roma, Venecia, but we call them by other names in a way that is utterly unwarranted. Every American resents having a Frenchman call our country Les Etats Unis, and properly, for it is not its name. There is no more sense in translating a geographic name than a person's name. A name is not a common noun, that it should be translated. The time is apparently not ripe for adopting the home names of all foreign geographic features, but, speaking for myself, I have no doubt that it will soon be feasible to institute this reform. Indeed, in almost every individual case of this sort that has been brought before the board the decision has been rendered in favor of the home name.

The universal adoption of this principle would, however, lead to many inconsistencies. For instance, in many cases what is plainly the same name appears in different parts of the United States as a designation of different features, with different spellings. In such cases should these different spellings be unified? The tendency of the board doubtless is in that direction, but in many cases they not only run against strong local usage but against legal authority as well. Wichita, Washita, and Ouachita are the same word; so with Wyandot, Wyandotte, and Guyandot. All are familiar with the name Allegheny, *hany*, *any*, applied to counties in New York, Pennsylvania, Virginia, West Virginia,

and North Carolina, and to mountain ranges and a river. As a county name it is spelled in three different forms, each of which is fortified by legislative acts, legal documents, and no end of local usage. It is desirable to make the spelling uniform; but can it be done? In such a case the board is between the devil and the deep sea. Consistency in following local usage produces inconsistency in orthography. In some cases of this sort, where the board was of the opinion that local usage could be overcome, it has adopted a uniform spelling, but in other cases it has refrained from making decisions.

In the matter of geographic names, as in everything else, development is constantly going on; names are continually changing, being modified in some cases slightly, in other cases radically. Is it best that this development should be suffered to go on blindly, as development has proceeded throughout the world in times past, or will it be more economical and will the results be more satisfactory and be attained at less cost if it be guided intelligently? Surely no one will hesitate to admit that the latter is the better condition. Recognizing this course of development in geographic names, the board has studied it with a view to ascertaining its trend, of discovering what changes are going on, and what their result is likely to be in the future, and, acting upon the knowledge thus acquired, it has endeavored to guide the course of development into the best channels, so as to produce good results from it as speedily as practicable. The most marked direction in which development is proceeding is that of simplification. Useless letters are being dropped, hyphens are being omitted; appendages to names, such as the word city, town, court-house, cross-roads, etc., are one after another being dropped. The possessive form of names is being given up. Life is too short to expend it in writing these useless words and letters. Names consisting of more than one word are being run together into one word. In these and many other ways the course of development is toward simplification and abbreviation. Of these changes the board heartily approves and it is going as fast and as far in the direction of furthering them as it believes the public will support it. To go faster or to go further at the present time would be to discredit itself, and this the board prefers not to do. Another tendency in development is toward uniformity in spelling. Certain names ending in *burg* were formerly spelled *burgh*, others *burg*, necessitating constant reference to gazetteers in order to learn whether the

name had a final *h* or not. The board at one stroke relieved the American public of this necessity by striking off the *h* in every case. The same thing was done with the termination *ugh* of *borough* and for the same purpose. Similarly the word *centre* is now uniformly spelled *center* wherever it appears as a part of a geographic name.

There is one other class of names to be considered, that is, names in remote, unsettled parts of the country, where there is no local usage. These are mainly of Indian origin, and they may be said to be still in an unsettled state, like the country in which they are found. How do we obtain Indian names? The spelling given to an Indian name represents the way in which some white man understood some Indian to pronounce it, and every one knows that in such a case there will be just as many different spellings of an Indian name as there are white men to hear it and Indians to pronounce it. From our Northwest we could, if space permitted, give hundreds of such names, each of them with a dozen or perhaps twenty different versions, and each version just as correct as any other. In such cases the board selects from among the different versions the one which seems to represent the sound the most clearly and most simply.

Early in the life of the board a long list of Alaskan names was submitted to it for decision. These names were referred by the board to some half-dozen gentlemen, all of whom were known as Alaskan geographers, and the subsequent decisions were based upon the weight of evidence submitted by these specialists. Of course, the decisions did not in all cases please all persons acquainted with Alaskan names.

In the matter of names in unsettled countries under foreign jurisdiction, the policy of the board has been to accept the spelling of the nation having jurisdiction there.

The work involved in making these decisions is in the main simple in character. Although much of it involves investigation, it is common every-day investigation, consisting mainly in finding out what people call themselves. The matters with which the board are concerned are not, as a rule, scientific matters. They are simply matters of fact or judgment. The board is often criticised for inconsistency in its decisions; with having decided one way in one case and a different way in another case which appears to be quite similar. I think the board is quite ready to plead guilty to the charge of inconsistency, but with extenuating circumstances, since consistency in certain matters involves inconsistency in others.

THE SEINE, THE MEUSE, AND THE MOSELLE

By William M. Davis

Professor of Physical Geography in Harvard University

II

Diversion of the upper Moselle from the Meuse.—After this long digression let us now return to the case of the Meuse and see whether indications can be found that any of its branches have been diverted to the basins of the Seine or of the Moselle. The first example to be mentioned is found in the neighborhood of Toul, and for simplicity of description I shall take the liberty of changing the names of the streams in this region in accordance with the adjoining diagram, the actual names being given in thin-lined letters, the assumed names in heavy-lined letters. The case may then be briefly stated as follows: The Toul (upper Moselle) once flowed through a meandering valley and joined the Meuse at the little village of Pagny-sur-Meuse. The meandering valley trenches an upland of middle oölite strata, but in the course of time the Pompey, a branch of the Moselle, pushed away the divide at its head, tapped the Toul where the city of that name now stands, and diverted it from the Meuse to the Moselle.*

The first fact to note is that the abandoned valley between Toul and Pagny swings on large curved meanders, after the

* My attention was first called to this example by my kind friend, M. Emm. de Margerie, who was so good as to refer me to the writings of several French authors by whom it had been described more or less fully and to whose essays I thereupon referred either in the original or in some citation. The earliest writer to make mention of this change in the course of the Toul seems to have been Boblaye, (1) who in 1829 reported that he found pebbles in the valley of the Meuse unlike the rocks of its upper basin, but like those of the upper valley of the Toul in the Vosges mountains. Buvignier (2) gave a fuller account of the same facts in 1852 and came to the same conclusion. Housson (3) wrote on the same subject in 1864, but I have not seen his article. The latest account of the case is by Godron (4) in 1876. All these authors recognize what may be called the geological evidence of the change, that is, the occurrence of pebbles from the Toul in the valley of the Meuse; but as far as I have read, they did not give particular care to the geographical features of the case. It is to these, therefore, that special attention is here called.

(1) Mem. sur la formation jurassique dans le nord de la France. Ann. Sci. Nat., 1829.

(2) Statistique géol. et min. du department de la Meuse, Paris, 1852.

(3) Origine de l'espèce humaine dans les environs de Toul. Pont-a Mousson, 1864.

(4) Ann. Club Alpin français, xiii, 1876, 442–457.

fashion often assumed by the valleys of large rivers, but never imitated by valleys of small streams. It is true that the valleys of small streams may in the course of time become comparatively wide, but they can never develop systematically curving meanders of large radius with steep sloping bluffs on the outside of the curves and long sloping spurs on the inside of the curves. The form of the valley from Toul to Pagny, therefore, at once suggests not only that a stream once passed through it, but also that the stream was a large one.

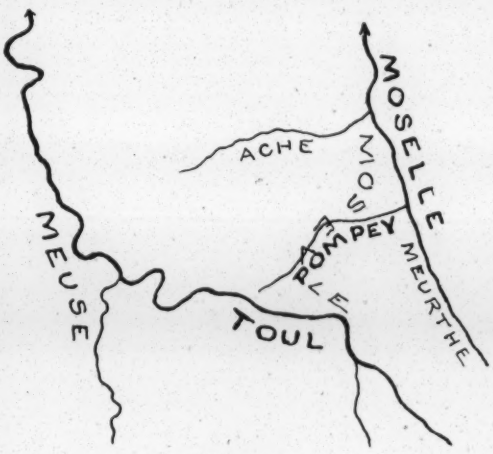


FIGURE 3.

In the second place, on looking more closely at the topographic details in the neighborhood of Toul, it is seen that we have here a well developed elbow of capture—a sharp bend in the river course, independent of local rock structure. The Toul makes a sharp turn from the direction of its upper course and swings off along the course of the Pompey to the Moselle. The Pompey was once merely one of many small branches of the Moselle, of which the neighboring Ache may be taken as the type; but in consequence of adding the large vol-

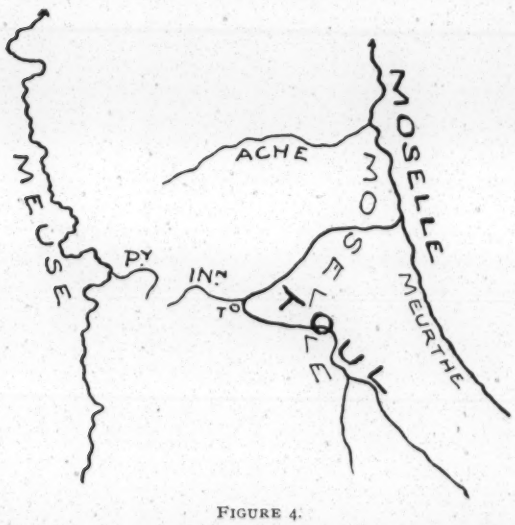


FIGURE 4.

ume of the Toul to the formerly small volume of the Pompey, the valley has been distinctly deepened both down and upstream from the elbow of capture below the former level of the streams and now exhibits the steep-sided trench characteristic of recent captures. Not only the diverted Toul but several of its branches above the elbow of capture have intrenched themselves beneath the general level of the open valley-plain of lower oölite strata on which they formerly flowed. On restoring the surface of this old valley floor by filling up the trenches which now dissect it, it may be seen to slope at such a grade as would lead it to the floor of the meandering valley on the way to the Meuse. Immediately after the division of the Toul we may imagine that only a small stream—the Pagny—fed by the drainage from the valley slopes, was left to follow the meandering valley to Meuse. This would be the diminished, beheaded stream of our terminology. But in consequence of the development of the deep trench at the elbow of capture and the accompanying growth of the obsequent stream—the Ingressin—the beheaded Pagny has been still further shortened and is now not more than two and one-half miles in length.*

The Pagny and the Ingressin.—Let me here turn a moment from the main subject to consider some special features of the meandering valley and its present occupants, the Pagny and the Ingressin. In the first place, midway in the valley, at the village of Foug, there is a little stream coming in from the Bois Romont on the north.. The topographic details of the district give good reason for thinking that this little stream used to join the valley at Lay-St.-Remy on the next meander to the west, and thus we have here a repetition of an accident of the Ste. Austreberte type. When the vigorous Toul was running through this valley and widening its meander belt it must have pushed its swinging current so vigorously against the outer side of its curves that it cut through the ridge separating the Foug meander from the little stream on the north, and thus changed the mouth of its own tributary from a lower to an upper meander. This may be added to the evidence indicating the former passage of a large river through the meandering valley.

Next as to the obsequent Ingressin, whose head is at least six

* The following altitudes are significant:
Junction of the Meurthe and the Moselle at Pompey, about 190 m.
Elbow of capture at Toul, 204 m.
Old valley floor at elbow of capture, about 255 m.
Divide between Ingressin and Pagny, 265 m.
Junction of the Pagny and the Meuse, 245 m.

miles from the elbow. The comparative narrowness of the trench both above and below the elbow of capture by Toul would not lead us to expect an obsequent stream of much length, and I therefore suggest the following explanation of the rather surprising length of the Ingressin. A little southwest of Foug is the narrowest part of the old valley, its narrowness here being due to the greater resistance of the middle Oölite, which form the highland through which it is cut. From these steep slopes it appears that a significant amount of waste has crept down into the valley trough, obstructing it more or less and producing a swamp of small dimensions. The beheaded Pagny seems to have been unable to hold its course through this obstruction. It probably accumulated for a time in a shallow lake above the obstruction, until on overflowing into the gorge at the elbow this part of its course reversed its direction of flow, and thus gave rise to an obsequent stream of a somewhat aberrant type which is now called the Ingressin.

All this, however, only by way of suggestion. Further study of the geographical aspects of the country is necessary before this suggestion deserves acceptance. There need, however, be no doubt on the general problem concerning the diversion of the Toul from the Meuse to the Moselle, and to my mind the case would be perfectly satisfactory if no pebbles from the Vosges had ever been found in the valley of the Meuse below Pagny. The dimensions of the meandering valley, the systematic form of its bluffs and curves, the gorge above and below the elbow of capture at Toul, the relation of the old valley plain in which the gorge was cut to the floor of the meandering valley that leads through the upland, and the accident that happened to the little side stream at Foug, all combine into so systematic an arrangement of parts as to leave no doubt that an explanation which can account for them by a single and simple process is their true explanation.

The diminished Meuse.—Looking now again at the Meuse by Commercy we must recognize it as a river whose volume has been diminished by the diversion of an important tributary to another river system. Its volume having diminished, it is unable now to accommodate itself to the large curves of its valley and must instead advance in an uncertain course as it staggers along on the valley floor. Not only so; having lost volume, it seems unable to maintain so gentle a slope as it had assumed when its volume was larger, for its flood-plain now has every appearance of hav-

ing filled up the former valley-trough to a moderate depth. It therefore gives us an illustration of a river which has changed its action from degrading its slope when its volume was large to aggrading its slope now that its volume is small.

What the Meuse has lost the Moselle has gained, and the considerable addition that the Toul has given to its volume has undoubtedly confirmed its habit of swinging boldly around the meanders of its lower valley, even to the point of cutting almost or quite through the necks of its meander spurs.

The Aire and the Bar.—Let us next look at the case of the Aire. This stream was once an affluent of the Meuse on the western side of its basin, but it has been diverted to swell the volume of the Seine. The elbow of capture in this case lies about two miles east of Grand Pré. The Aire coming from the southeast here makes a sharp turn westward through the ridge of lower Cretaceous strata that bears the forest of Argonne and thus joins the Aisne. In direct continuation of the course of the Aire an open valley leads to the Meuse a little below Sedan. The greater length of this valley is followed by a small stream—the Bar; but while the valley exhibits strong meanders of rather large radius, the Bar is nothing but a little brook that wriggles here and there, back and forth, on the valley floor. The slopes of the valley floor have the usual systematic arrangement—steeper slopes on the outside of the curves, gentler slopes on the inside. A spur that enters one of the meanders from the upland on the west, covered by the Bois la Queue near St Aignan, has so narrow a neck that the canal leading from the Meuse to the Seine system has cut a trench through the neck instead of going around the spur. (See Plate V.)

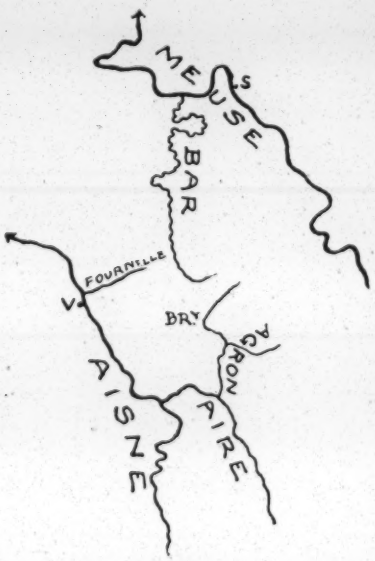


FIGURE 5.

The indications of the former greater volume of water in the stream that once swung boldly around the meanders of this valley are perfectly conclusive. But now the little Bar staggers

about in the most random manner, quite unable to continue the widening of the meanders and the narrowing of the necks of the spurs by running systematically against the outer side of the valley curves. The meadow-like quality of the flat valley floor suggests that the Bar has aggraded its course since the greater volume of water was withdrawn at the Grand Pré elbow, thus repeating the features of the Meuse about Commercy. Following up the Bar, the breadth of the valley and the radius of its large meanders are slowly diminished for a long distance; but the little Bar winding through the meadow floor, rapidly diminishes, and near Buzancy the meadow is left without more drainage than is given by such ditches as the farmers have cut here and there for the better drying of their flat, marshy fields. Passing further to the southeast along the meandering valley, we soon find a small stream, successively called the Moulin, Briquenay, and Agron, flowing southward for seven miles in a trench cut along the valley-trough to the elbow of capture above Grand Pré. This is the back-handed stream by whose growth from the elbow of capture the beheaded Bar has been progressively more and more shortened.

Whether the divide at present existing between the obsequent Briquenay-Agron and the beheaded Bar has been determined in this case by the accumulation of detritus washed in from the valley slopes, as it apparently was in the case of the Pagny, I cannot surely say; but there does not appear to be much disparity between the time required for the amount of widening that the gorge of the Aire has received at the elbow of capture and for the headward growth of the back-handed Briquenay-Agron. As in the case of the Toul (upper Moselle), so with the Aire; its old valley floor, occupied at a time when it still ran down the valley now occupied by the Bar, is easily recognized in the flat, terrace-like benches in either direction from the elbow of capture; but these benches now overlook the widened trench of the diverted Aire and the narrower trench of the reversed Briquenay-Agron. A considerable depth is maintained by the trench of the Aire for some distance up the stream from the elbow of capture, and, of course, also through the former valley floor of the diverter on the way to Aisne; but on going up the reversed stream its trench rapidly decreases in depth, and near Buzancy it makes but a slight depression in the meadows.

One of the most interesting points of view for the appreciation of this example of river arrangement is on the flat fields of the

old valley floor near the elbow of capture, just south of the village of Champigneules. Here all the different parts are easily recognized, as if on a model made expressly for the explanation of the problem. In some pits dug here and there by the roadside on the plain one may see the old river gravels laid down by the Aire while it was running at this high level on its way northward to the Meuse. Another point of view no less instructive is offered after surmounting the hill by which the national road southward from Sedan, on the Meuse, crosses over to the valley of the Bar at Chevenges. From the summit and along the southward descent one has a beautiful view of the broad valley as it swings around the narrow-necked spur of the Bois la Queue, but he looks in vain for the stream by which the valley was cut. He fails to see any stream at all until descending to the valley floor, when the only occupant of the great, boldly swinging valley is found to be a little meadow brook.

Here, as before, it should be remembered that it is not the width of the valley that is essentially discordant with the size of the brook that now drains it; for in the late maturity of the geographical development of a land surface even small streams have broad valleys. The discordance which proclaims that the valley is not the work of the existing stream is seen in the relative dimensions of their meanders. The valley swings regularly in curves of at least half a mile in radius, and maintains this habit of curvature with small diminution far up toward the elbow of capture and probably still further south. The stream turns and twists in curves whose radius may often be less than a hundred feet.*

In comparing the case of the Toul (upper Moselle) and Aire, we see that these rivers are the diverted upper portions of

* The following altitudes are instructive:

Junction of Bar and Meuse	153 m.
Divide in old valley-trough between the beheaded Bar and the reversed Briquenay-Agron on the meadows west of Buzancy	175 m.
Junction of the reversed Briquenay-Agron with the Aire at the elbow of capture	130 m.
Floor of old Aire valley at elbow of capture	182 m.
Junction of Aire and Aisne	113 m.
The advantage of depth thus gained by the Aire is about	50 m.

It is worth noticing that if the Aire had not been diverted at Grand Pré it would have soon been captured farther down its former valley at Brieulles-sur-Bar for here the Fournelle, a branch of the Aisne, has almost cut through the forested ridge of Argonne, as the following heights show:

Mouth of Fournelle in Aisne by Vouziers	100 m.
Divide between head of Fournelle and Bar near Noirval	174 m.
Bar at Brieulles	168 m.

branches that once belonged to the Meuse. The diverters (by which the Toul was given over to the Moselle and the Aire to the Aisne) may be called the Pompey and the Grand Pré respectively, the latter ultimately delivering its prize through the Marne to the Seine. The beheaded streams of the two are the Pagny and the Bar. The former is so insignificant that I have had to invent a name for it, finding no name for the stream but only the "Marais de Pagny" entered on the Etat-major map of 1 : 80,000. The Bar is the best example that I have ever seen of a beheaded stream trying ineffectually to live up to the robust habits of its great predecessor.

The diminished Meuse again.—The loss suffered by the Meuse and the increase gained by the Seine through the diversion of the Aire are of no great moment, but as far as they go they serve to confirm each river in the habits that now characterize it—the Meuse in staggering with uncertain steps around its valley curves, the Seine and the Moselle in swinging boldly around their curves and undermining the inclosing bluffs. It should be noted, however, that when a large tributary is diverted from a point high up on the trunk of a main river, the loss of volume that the change produces may be a large fraction of the total volume that once belonged to the main river, and hence that the loss may greatly affect the ability of the main river still to follow the swinging valley that it cut out when its volume was greater. On the other hand, when a tributary of relatively small volume is diverted from some point near the middle of the main river, the loss thus occasioned will be a comparatively small fraction of the trunk volume, and the change of habit thus produced will be correspondingly small. It is for this reason that the staggering of the Meuse near Commercy is so much more marked than between Sedan and Mézières. The loss of the Toul (upper Moselle) was a much more serious affair for the Meuse than the loss of the Aire.

Supplementary problems.—There are certain aspects of this problem that remain to be considered briefly. First, are there any other examples of branches diverted from the system of the Meuse to those of its neighbors on the west and east? Although I have been unable to find any direct signs of them on the map, there still does seem to be indication that other diversions have occurred. On looking at the Meuse above Pagny, it is there almost as much out of proportion to its valley as it is below Pagny. It is possible, therefore, that other headwater branches

higher up than the upper Moselle have been diverted. Looking at the Aire, it appears that the present radius of the meanders is much smaller than the radius of the swinging valley that is followed by the little Bar, and from this it may be inferred that not only the existing Aire but the drainage of a still larger basin once ran down the valley of the Bar. Perhaps the upper Ornain represents something of the additional volume that the Aire once possessed, but I cannot find direct indication that such is the fact. The maps on the scale of 1 : 80,000 seem hardly of sufficient detail to enable one to solve this phase of the problem by indoor study alone. The whole subject calls for extended study in the field, and a more interesting problem could hardly be selected for a summer's work.

Another subject to which no reference has yet been made is, nevertheless, of fundamental importance to the whole problem: Why is it that the Seine and the Moselle are waxing at the expense of the waning Meuse? Why do they possess an advantage while the intermediate stream is at a disadvantage? How could the Meuse ever have gained so large a drainage area as it once must have had, if at a later stage of its history it was to be so closely shorn of its branches? This is too large a problem to enter far upon now, but it contains two elements that may be briefly stated. One is that many of the streams in the region of the Meuse are longitudinal streams—that is, they run chiefly along the strike of the weaker strata and their valleys have long ascending slopes on the eastern side and more abrupt slopes on the western side. The highlands reached by these slopes are determined by the outcrop of more resistant strata than those of the valleys which the streams have excavated. Longitudinal streams of this kind I have called "*subsequent*," believing that they cannot have originated in immediate consequence of the original slopes of the land surface when it first arose above the sea, but that their opportunity came later when the wasting of the weak strata allowed the headward growth of streams along their strike, after the manner explained in connection with the adjustments of the Marne and its branches near Châlons. The Meuse and at least some of the branches that it once had therefore seem themselves to have been the result of depredations committed on the territory of some still earlier river or rivers, and if this is true, the sympathy that the present impoverished condition of the Meuse excites is not deserved.

However this may be, why is it that the Meuse has lately

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

THE LOWER VALLEY OF THE BAR

Sheet 24, Map of France, 1 : 80,000

found so great difficulty in deepening its valley and thus saving its branches from capture by its neighbors? The chief cause of this difficulty must be looked for in the uplift of the Ardennes, across whose resistant rocks the lower Meuse has, during Tertiary time (perhaps only during later Tertiary time), been cutting its grand gorge. Like the highlands of the middle Rhine, the Ardennes consist of ancient and deformed rocks which have once been reduced to a peneplain of moderate relief drained by idle streams,* but across which the Meuse is now actively cutting a deep transverse valley in consequence of the strong uplift of the region. While the peneplain was yet a lowland the Meuse was comparatively safe from depredations, but during the elevation of the peneplain and thereafter, great difficulty must have been experienced in deepening the valley. The Moselle must also have had some difficulty in deepening its valley through the uplifted highlands of the middle Rhine, but the uplift there does not seem to have been so great as it was in the Ardennes, and thus the Seine and the Moselle seem to have gained an advantage over the unlucky river between their headwaters. It is, indeed, remarkable enough that the Meuse is still able to maintain its course across the uplifted Ardennes, and its success can only be explained by regarding it as an excellent example of an antecedent river. It has battled manfully to preserve its course, and in this it has been wonderfully successful, for the highlands

* This view of the history of the Ardennes is strongly presented in an essay by Professor de Lapparent, entitled "L'age des formes topographiques" (Rev. des questions scientifiques, October, 1894); but there is one conclusion that he announces from which, if I understand him correctly, I must differ. Professor de Lapparent states that at the beginning of Tertiary time, when the Ardennes were denuded close to the level of the sea, "the streams there circulated capriciously and almost with out slope on the surface of a region devoid of relief." The "capricious" arrangement of the streams seems to me very unlikely. Inasmuch as the present drainage of the Ardennes is for the most part accomplished by a rectangular system of streams, which follow longitudinal courses along the weaker strata and transverse courses across the stronger strata, it seems advisable to picture the peneplain to which the Ardennes were reduced as still possessing faint residuals of the many ridges that once rose above the peneplain, and to conceive the streams as exhibiting a well-adjusted relation to the structures, such as they would have slowly and laboriously acquired during the making of a peneplain from a once mountainous region of disorderly structure. The present rectangular streams would then be, not the readjusted successors of a capricious system of drainage on the peneplain, but the persistent successors of the laboriously adjusted streams of pre-Tertiary beginning. If some of the streams of the Ardennes now exhibit capricious courses, unrelated to the structure in which their valleys are incised, they may be the successors of late Tertiary streams that had lost the adjustment of maturity in the meandering of old age, or they may be inherited from courses that were assumed on a cover of unconformably superposed strata of late Cretaceous or early Tertiary date, now all stripped off; but, as far as I have seen the region and studied the maps, capricious streams of this kind do not prevail. The characteristic rectangular streams are well shown on sheets 48 and 54 of the Belgian topographical maps; scale, 1:40,000.

of the Ardennes through which its deep gorge is cut are now higher than the uplands in which its meandering valley is sunk for some distance above Mézières. Yet although successful in holding its way through the revived mountains of the Ardennes, it has had to pay dearly for this success by the loss of its side branches. The hard rocks of the uplifted Ardennes form a sill that holds the upper Meuse at a relatively high level and allows the head branches of the Seine and Moselle to undercut it on either side. Thus it is left as a waning river, still persevering bravely in its course, but much embarrassed by the diversion to its encroaching neighbors of certain tributaries from whom it had expected loyal assistance in its great task of cutting a way through all obstacles to the sea.

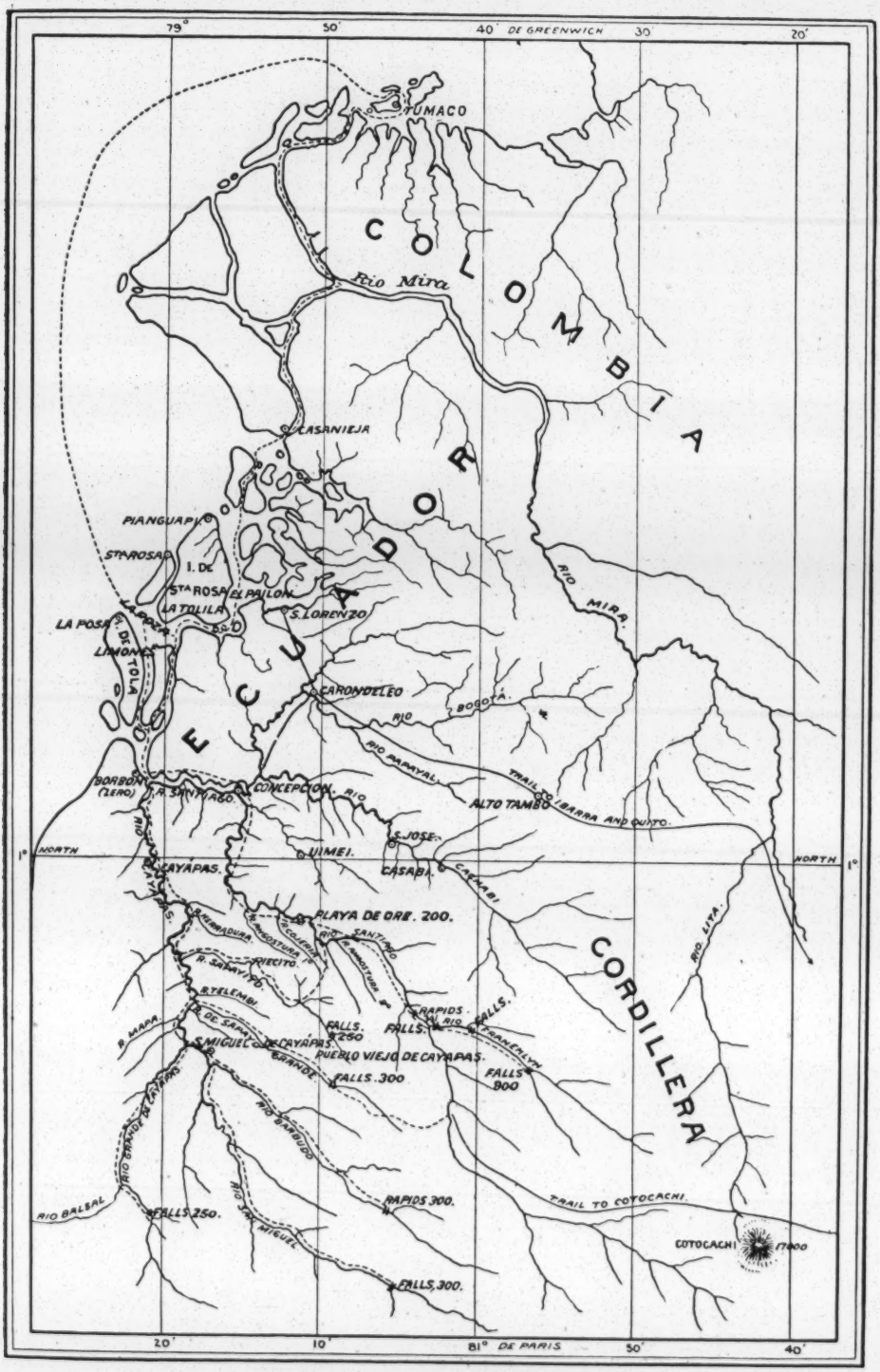
A JOURNEY IN ECUADOR

By Mark B. Kerr, C. E.

I left Panama on June 26, 1894, and two days later made my first stop at Buenaventura. Here a Californian, Mr J. L. Cherry, is building a railroad to the interior of Colombia, to penetrate Cauca valley, probably the richest district in quartz and placer gold mines in South America. The railroad here has been completed to Cordoba, some thirty or forty miles inland from this town. Transportation across the mountains is effected by packing.

On June 30 I arrived at Tumaco, on the borders of Colombia and Ecuador, at the mouth of Rio Mira. From this point inland *via* Patia river and Barbacoas another mule trail leads to the interior of Colombia, this and the one already noted being the only ways of reaching the interior from the Pacific. At Tumaco the fruit is delicious, mangoes, pineapples, oranges, and apricots being finer than at any other place I visited.

The next river southward (in Ecuador) is Rio Santiago. Between this river and the Mira there is at high water a deep and narrow interior channel or sound, which is generally traversed by canoe in preference to the rougher outside journey by sea. In this portion of Ecuador transportation is entirely by canoe, as the Andes rise abruptly from the Pacific, culminating in the immense peaks of Chimborazo (20,498 feet) and Cotopaxi (19,480 feet). The only regular route to the interior in Ecuador is the



DRAINAGE MAP OF NORTHWESTERN ECUADOR

From the Survey of Mark B. Kerr, Civil Engineer, and R. M. Arango, Assistant Engineer

Coast line and adjacent country from the Ecuador Government Survey, by courtesy of C. Van Eschott, Esq., of Guayaquil, Ecuador

Elevation above sea level shown in figures

Kerr's route ----------

rough road from Guayaquil to Quito, crossing the Andes at an elevation of 14,000 feet just south of Chimborazo.

On the journey from Tumaco I was accompanied by an Englishman named Nelson. The first day out we stopped for the night in this interior channel. The vegetation was dense and thick, and parasitic vines stretched completely across the waterway. Many different kinds of parrots combined with innumerable insects and lizards and a few monkeys to make night hideous; and when a sharp, curious noise like a dog-bark caused my friend to thrust his head from under his leafy canopy in the canoe to inquire, "What is that noise?" I answered "An equi snake." Nelson dropped back under his ranch, and when he ventured out in the morning remarked, "What an infernal country, when even the snakes bark!"

We followed the inland passage to the mouth of Rio Santiago and ascended this river 12 miles to Borbon. The passage was so narrow and the vegetation so thick as to give the impression of floating through a forest. At Borbon we found a warehouse which thereafter served as our base of supplies. The Spaniards knew of gold placers on the Santiago over two hundred years ago and brought in negro slaves to work them. The descendants of these slaves now people one branch of the river, numbering over 1,500. They crowded out the natives (the Cayapas Indians, about 1,000 in number), who retired to another fork of the same river. At Borbon the Santiago forks, the left (northern) and decidedly smaller branch retaining the name, while the right fork is called Cayapas, after the native tribe. The old semi-civilization of South America and Central America seems to have been confined to the elevated plateaus, particularly in Peru and Ecuador, and there only do we find ruins of the remarkable buildings constructed by the Incas, such as those of Quito, Cuzco, and Lake Titicaca. When Pizarro conquered this region in the earlier half of the sixteenth century many of these people fled before the conquistador and established new homes along the banks of these torrential rivers, which plunge into the Pacific after a limited course, usually 75 to 100 miles. These rivers would seem magnificent if they were not surpassed by the grandeur of their neighbors, the Orinoco and the Amazon. Santiago river and its branches rise in the snowy crest of the Andes, and the Cayapas Indians are probably descendants of the Chimec or Chibcha, who, conquered neither by Inca nor Spaniard, retired to remote districts and held themselves aloof from strangers.

RESIDENCE OF THE GOBERNADOR OF THE CAYAPAS INDIANS, ON THE RIO CAYAPAS, ECUADOR

From an Original Photograph by Mark B. Kerr, C. E.

Along most of the rivers descending from the Andes to the Pacific in Ecuador gold was found in small quantities by the Spaniards. In this eager search for the yellow metal the Indians were forced to give way, and now in their homes along the banks of the Cayapas they meet all strangers in an inhospitable and surly manner. The negroes have borrowed many customs and useful arts in weaving, house-building, etc., from the Cayapas Indians, and, having retained many old habits of their former African abode, combined with some of the worst traits of the inferior whites, may be summed up as being phlegmatic, ignorant, superstitious, without strong family ties or sense of gratitude. Their superstitions take the form of incantations to prevent accidents, and especial trouble is taken to prevent the devil from taking possession of infants. Some respect is felt for the priest who occasionally visits here, but with these negroes religion is only another word for superstition.

But to return to my journey On July 17 we left Borbon and proceeded by steam launch 28 miles up Rio Cayapas. Grasses, ferns, and bushes (mostly of the class Umbelliferæ) lined the banks and mingled with the cocoanut trees, the breadfruit, the splendid royal palm, and the mango with its spreading and symmetrical foliage. These magnificent trees with their large leaves strained imagination to the utmost and utterly deceived the eye in grasping proportions. While lost in silent admiration of such a wealth of vegetation, we turned a sharp bend of the river and over the thatched huts of the natives could be seen the overhanging feathery tufts of the bamboo, which softened as well as lightened up the intensely dark hue of vegetation in the background. This was the headquarters of Napo, the gobernador of the Cayapas. A judicious presentation of beads and buttons insured us a pleasant reception from the chief, and he detailed a guide for us on the upper river.

The house of the gobernador was on stilts (as is the case with most of these houses) and was built like a long rectangle, 100 by 60 feet. Two large fireplaces (wooden boxes elevated about three or four feet above the floor and filled with sand) and some large flat stones sufficed for cooking purposes, while four small extensions, two on each side of the house, like bay windows, served as sleeping apartments for the different members of the family. The men are well formed, of good stature, beardless, with glossy black hair, and splendid chest development, while the women, being forced to do all the work, are generally small,

coarsely fat, and disfigured by black streaks across their faces arms, and breasts. They wear an embroidered cloth of their own manufacture tied around the waist and reaching to the knee, and the men wear a garment like swimming trunks, made of the same material.

Boiled plantain beaten into cakes between two flat stones constituted supper and breakfast. After supper the women engaged in weaving cloth from shreds of plantain fiber, and through this embroidered long pieces of cotton dyed by rolling cotton in natural blues and reds through the cloth like wax-ends. This cloth, all hand-made, was when completed extremely handsome, reminding one of the figures and coloring of German embroidery. The men amused themselves lolling in hammocks or playing on the marimba, an instrument made of upright pieces of bamboo with pieces of hard wood laid across them, in tone like a xylophone. Sometimes they played minor chords on another instrument like a harp. A fire of a sort of resinous wood served to light up the scene until night fell black and damp, and we were lulled to sleep by the crackling flight of large beetles and the occasional hoarse bark of a tree-frog or lizard.

Early the next morning we visited the trapiche or sugar-cane press of the chief. Here two huge wooden rollers set close together pressed the cane stalks and large metal vessels received the juice. Distilling pots were placed conveniently near. All the apparatus had apparently been in use for many years.

These natives make light and swift canoes and leaf-shape paddles, and are also skillful in weaving hats, fans, and hammocks from the many-colored rushes and grasses. From the "pita" they make fish nets and lines, and by whipping a small stream, diving, and keeping the net close to the bottom they inclose the fish in a small space, when men, women, and children have great sport in spearing them. Besides this, the men are skillful fishermen, and when the river is high an Indian can often be seen, with one hand holding his pole and the other propelling and guiding his canoe in a manner worthy of the most scientific sportsman. They also make a sort of vegetable cloth by beating off the outside covering of strips of Tanajaqua bark, which afterwards by repeated washings becomes pliable.

By some means of rapid signaling our progress up the river was anticipated, but thanks to the kind office of our friend, the gobernador, although not altogether hospitably received, we were still permitted to pass along without question. Along the whole

course of this river we found different clans living in communal style in these large houses, similar to the house of the chief, skillful in weaving cloth and carving figures out of wood, without doubt arts from a higher civilization. The custom of removing the bones from the head of the dead and then drying and embalming the latter seems confined to the Serranos on the upper plateaus, but I saw one of these heads, about the size of an ordinary ball, with perfect hair and features. This tribe is entirely pure, and although most of them understand the Spanish of the country, they use their own language among themselves.

Reaching the head of steam navigation, we again took to our canoes. The river, swollen by recent rains, rushed down at a furious rate, and the native boatmen, clinging to roots and overhanging bushes, used vigorously both paddle and pole, shouting and babbling to each other louder even than the roar of the water. We encountered mostly sedimentary rocks until we reached the Sapayo. The bed-rock then was soft and contained fossil shells, some of them belonging to the Chico group. A short distance up this river the formation changes. Immediately above an altered sandstone and slate and then granite and quartz occur. In the Sapollite the quartz is gold-bearing, but above it is barren. Further above occur the diabase rocks and lavas to the crest of the mountains. Outside of the Sapollite and Sapayo Grande the rocks are base, gabbro-like, and carry no gold. The float of the Sapayo Grande shows crystals of quartz and Brazilian topaz, but none of the stones we saw were valuable.

Having reached the head of canoe navigation on Cayapas river and made an examination of the placers there, we built a hut after the native fashion and made our second base camp. My plan was to cross the cordillera and examine the rocks and topography of the country between the rivers Cayapas and Santiago.

We found here an old trail running into the interior across the Andes to the town of Cotocachi. No white man had ever gone so high up the river or attempted the interesting journey across the Andes. On account of the heavy rainfall (about 30 inches a month) it is very difficult to preserve negatives, and even clothing soon becomes mildewed. A great many of my exposures were ruined and most of the negatives were spotted by the dampness. Thus my photographs are few and imperfect.

Leaving all our miscellaneous equipage at this camp, we decided to cut our way along the old trail. Never before in all my experience had I encountered such a wealth of vegetable

and insect life as here in the depth of the equatorial forest. Many-colored moths, butterflies, and humming-birds fluttered from plant to plant, and even snakes, toads, and lizards were clothed in prevailing bright hues. The snakes were generally about the size of the rattlesnake, with flat heads and large fangs, and many of them were venomous. The boa here does not reach so great a size as on the Amazon drainage, the largest we saw being eight feet long and three inches thick. On some of the smaller streams one species of reptile, light green in color, had an uncanny way of dropping unexpectedly from trees, once in awhile actually dropping into our canoe as we passed. Two large copper tanks were filled with different species of reptiles. One earthworm was found two feet long, a cockroach three inches, and a grasshopper three and one-half inches in length. Large fireflies, with two phosphorescent eyes, were plentiful; they made a crackling noise in flight. During the night we stuffed cotton in our ears, not alone to drown the droning and buzzing of the insects, but also to prevent the pests from crawling in while we slept.

Four or five natives in charge of an assistant were sent ahead with provisions, to put up ranches (a ranch here is a temporary camp) of cane and palm leaves, and with three others I brought up the rear. The vegetation changed somewhat and became semi-tropical in character, the red cedar predominating, and although there was not the same dense jungle as below, still the underbrush was luxuriant, and our machete men were kept busy in cutting out the large tangled roots and dense vegetation which obstructed our path up the ridges. As we ascended the stream we noticed many butterflies on the playas. Toward evening the number increased until for an hour they passed over our heads in perfect swarms like locusts.

We passed two falls by swimming and climbing along the edge of the rocky bank until it was too steep to even afford foothold. We then made a raft of light balsa wood and passed along the cliffs to the third fall. Wearied by our work, we pitched our tent along the edge of the cañon about thirty-five feet above the water. For the sake of convenience our Jamaican cook had pitched his camp under a shelving rock about twenty feet above the water. Shortly after dark we heard the distant thunder in the mountains, and in two hours, before we had even time to realize what had happened, the water came down in one solid sheet of white foam and washed our kitchen away, leaving us,

however, the cook. The water rose thirty feet, and then gradually subsided, having just missed carrying away our entire camp.

After we left the river one high ridge was reached only to plunge again into a ravine on the other side, for the trail carried us across the many forks of the Sapayo Grande. We made only four or five miles a day. One day, having a particularly rough and difficult journey to make, we failed to reach our camp and remained all night upon the cordillera. The darkness fell rapidly. Suddenly a peal of thunder was heard, followed by a sound like a rushing, furious wind through the tree-tops, the signal of approaching rain. It came in torrents, wetting us through and through, and putting out our fire. The earth, like a sponge filled to repletion, received and gave off its additional moisture, making the air intensely humid. We sat up the rest of the night, clinging to the roots of the trees, hearing the whirr of innumerable birds, the buzz of countless insects, and the howling of wild cats, while large firebugs and a phosphorescent gleam from decayed vegetation spread a weird glow that only served to intensify the darkness.

On the fourth day we reached the main divide or cordillera overlooking Rio Santiago, 8,000 feet above the sea, and leading direct to the summit of Cotocachi. This peak is included in the scheme of triangulation and observation of Jùan and Ulloa, Humboldt and Pissis. At this point the Andes begin to show their power; numerous streams fall in beautiful cascades over the cliffs and disappear in the vegetation below, while not far away looms up a snowy summit, 17,000 feet above sea level.

After extending our reconnaissance to the river we returned over our trail and down the Cayapas to the headquarters at Borbon. For some reason we were avoided by the natives, and even treated with open signs of enmity. However, we had accomplished all we wished in limiting the areas containing gold gravel and in making a rough but interesting trip in a very short time.

THE ABERRATION OF SOUND AS ILLUSTRATED BY THE BERKELEY POWDER EXPLOSION

By Robert H. Chapman,

United States Geological Survey

Dr Charles A. White* and Mr Arnold B. Johnson† have treated of the sounds given by fog-sirens. They have discovered areas close to the siren in which the sound is inaudible. In some cases this fact is accounted for by the intervention of an object, such as an island or mountain, but not infrequently there is no visible obstruction to the sound waves coming from the siren. It is my wish to present some facts that have come within my own observation and that show a direct relationship between sound waves and waves of motion generated by sharp explosions.

On Saturday, July 9, 1892, about 9.30 a. m., an explosion occurred at the giant-powder works at West Berkeley, California. The first explosion was in the "mixing-room," and about 1,000 pounds of nitro-glycerine were discharged. About five minutes later the three magazines blew up, the final explosion being the heaviest. The total amount of powder and nitro-glycerine exploded was about 250 tons. The shock of the last explosion was very severe, the column of smoke and flame rising to a height of at least 1,200 feet, and resembling a volcanic eruption. The damage in San Francisco, eight miles across the bay, was very great, plate-glass windows being broken, doors forced, and skylights shattered. Tne shock seemed to be a little heavier in the low-lying portion of the city, although farther from the scene of the explosion, than in the hilly quarter. It was distinctly felt by the engineer and passengers of a rapidly moving express train 12 miles north of the works. A train only five miles distant was partially protected by hills, and no shock was noticed. At Napa, 28 miles due north, the shock was distinctly noticeable.

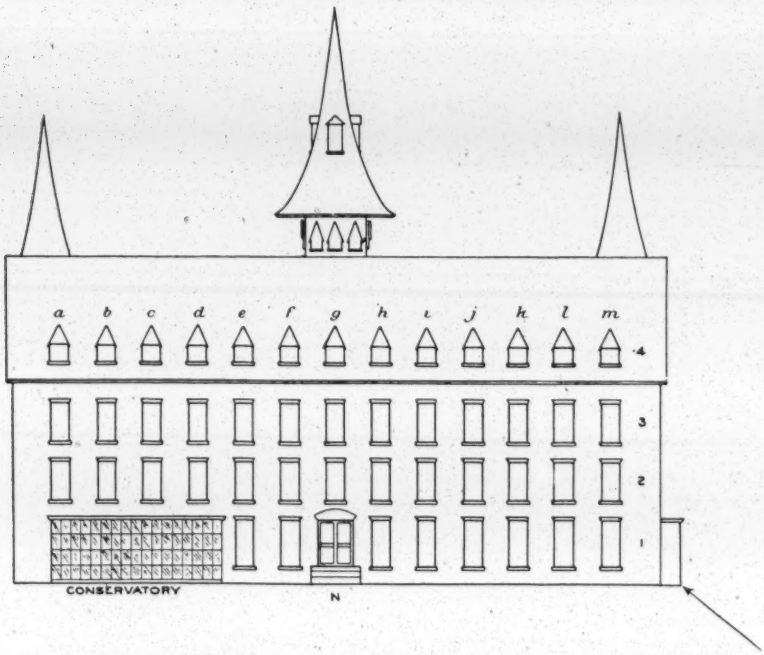
About one and one-half miles a little south of east of the works and at about 100 feet higher elevation is situated a large frame

* *Science*, vol. xxiii, pp. 59-62, The Relation of the Sounds of Fog Signals to other Sounds.

† *Science*, vol. xxiii, pp. 3-6, The Cruise of the *Clover*.

See also The Modern Light-house Service, pp. 74-91, A. B. Johnson, and Report upon Fog-signal Experiments (Report of the Light-house Board, 1894, Appendix No. V), pp. 289-304, W. R. Livermore.

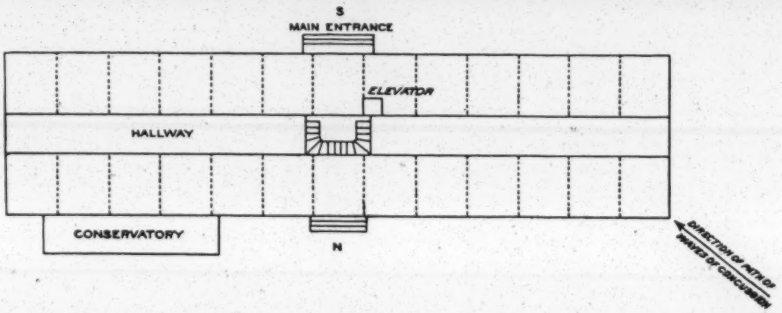
building, built for hotel purposes, and having a great number of rooms and windows. It was used at that time as a young ladies' seminary, but the explosion occurred during vacation, and the president of the institution and his family were the only persons occupying it. Accordingly most of the rooms were vacant and the doors and windows closed. The dimensions of the building are about 200 feet in an east-west direction by 50 feet north and south, and it is several stories high. On the first floor are large dining-rooms, reception-rooms, etc, with a hallway in the middle



of the building. The upper stories have a hallway running east and west for the entire length of the building, doors opening to rooms on each side of the hall, and transoms over the doors, with elevator and stairways in the middle of the building, as shown in the accompanying ground plan and profile, which, however, are given as correct only as to their general features. For convenience, the windows shown in the sketch are numbered vertically from the bottom and lettered consecutively from the left.

The conservatory, on the north side of the building, was badly broken, both glass and framework, the latter being moved out-

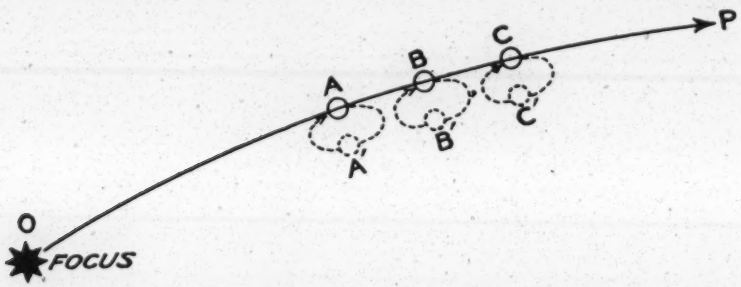
ward, or toward the focus of action. All the windows on the western end of the building were broken, while those on the eastern end were uninjured. The direction of the waves of motion was toward the northwest corner of the building. On examining the column marked *b*, I found window 2 blown in and its frame broken into small pieces. Window 3 was uninjured, while 4 was in a condition similar to 2, both glass and frame being broken. This skipping of alternate windows in the same vertical line was remarked in several instances, but the broken windows were not always in the same horizontal line. I remarked no systematic alternations in injuries to windows of the same story. In some cases the transom above the door of a room, the door and window being shut, was broken, glass and frame, the door blown in toward the room and broken from the hinges and



lock, the window remaining uninjured. Many windows on the south side of the building, the side unexposed to the direct force of the explosion, were broken and many doors on the south side of the hallway were broken and unhinged. The large doors at the entrance of the building on the south side were broken from hinges, lock, and floor-bolt; one was blown in and the other blown out. No damage was noted in the vicinity of the elevator shaft, where the air in the building was free to circulate. The general rule appeared to be that the doors were forced toward the room or hallway having the greater cubical contents. Looking at the north side of the building, one was impressed with the fact that it appeared to have been bombarded, the windows being broken in groups. This seems to bear out, to some extent at least, the assertion of Professor P. G. Tait, that "in the case of a disturbance in air due to a very sudden explosion, as of dynamite or as by the passage of a flash of lightning, it is prob-

able that for some distance from the source the motion is of a projectile character."*

The breaking of the transoms over doors, while the window was uninjured, and the breaking of the windows unexposed to the direct force of the explosion are very interesting phenomena, and I wish to offer an explanation which I think will account for the facts observed. The path of the maximum of disturbance results largely from the unequal resistance of the air, and while at the actual center of explosion the pressure may be in "concentric shells," at a very short distance it becomes stellar. The changing pressure of the wind, as shown by Professor Langley's experiments, and the shape of the flame in an explosion (stellar) lead one to this conclusion. As the maximum wave moves from the focus, the air forming it is constantly changing, and the following sketch illustrates the path of an air particle as I believe it to be:



A, *B*, and *C* are air particles in the path of a maximum wave traveling along the line *O P*. The motion of each is first along the line of *O P*, away from the focus, a result of direct impact of other particles, then back to its original position, or near it, the track forming a closed curve. When the particle is in the position *A'*, *B'*, or *C'*, its motion is toward the focus of the explosion, and so any damage it might do would be evidenced by a breaking of objects unexposed to the force of the direct wave. In the case of the transoms mentioned above, the back thrust which broke the glass and frame was cushioned by the air in the room, and so the window was not injured.

* *Encyclopædia Britannica*, ninth edition, vol. xxiv, p. 418.

MINERAL PRODUCTION IN THE UNITED STATES

The mineral products of the United States in the calendar year 1895 had a total value, according to the statistics collected by the U. S. Geological Survey, of $611,795,290. This amount, although nearly one-sixth greater than that for the preceding year, was less than in 1890, 1891, or 1892. The quantities of the principal items were, however, greater than ever before, while the values were in many cases less, owing to the reduction in prices.

The most noteworthy increase in the list is in the case of pig iron, the quantity of which increased nearly 42 per cent, viz., from 6,657,388 long tons to 9,446,308 long tons, and the value nearly 62 per cent, viz., from $65,007,247 to $105,198,550. This production is the largest the country has ever seen and is probably not far from double that of the British islands. The decrease in silver production has continued, the amount produced being 47,000,000 ounces, or about 2½ million ounces less than the year before. The production of gold has greatly increased, being $47,000,000 against $39,500,000 in 1894. The product of the Transvaal was almost equal to that of this country. The production of copper has increased slightly, being 381,106,868 pounds. The production of lead also has increased, reaching 161,440 short tons. The output of coal consisted of 135,118,193 short tons of bituminous and 51,785,122 long tons of Pennsylvania anthracite. The output of coal, both bituminous and anthracite, is the largest on record. The production of petroleum was 52,983,526 barrels of 42 gallons each, the largest amount ever produced in a single year with the exception of 1891. The production of natural gas has slightly diminished.

The enormous increase in some of these items, especially those of pig iron and coal, illustrates in emphatic terms the promptness with which the supply of such products responds to an increased demand. For two years the railroads of the United States were economizing in the purchase of rails, with the result that at the end of that time an unusually large number of lines were needing new rails, and the different companies took advantage of the low price of steel to supply their necessities in this regard. The result was a large and sudden demand for steel rails, causing a great increase in price; mines and furnaces were reopened, and general activity prevailed in the trade, resulting, as before stated, in an increase in the iron output of nearly 42 per cent over the previous year. In the case of most of our mineral products the output is limited only by the market. The supply and the facilities for extraction are more than sufficient to meet any possible demand.

GEOGRAPHIC NOTES

EUROPE

ENGLAND. Four additional wires, mainly for telephone purposes, are to be laid between London and Paris.

A census taken in March last found the population of London, exclusive of the outer suburbs, to be 4,411,271, an increase of 199,528 in five years.

ASIA

INDIA. In 1895 new railways aggregating over 800 miles in length were opened, while nearly 3,800 miles were under construction or sanctioned. The net earnings of the Indian railways averaged 5.78 per cent.

CHINA. The imports during 1895 amounted to 171,696,715 taels (the tael fluctuating between 65 and 74 cents), against 162,102,911 taels in 1894. The exports amounted to 143,293,211 taels, against 128,104,522 taels in 1894. Silk is now a more important export article than tea. Raw cotton, also, is an export that is increasing very rapidly. Of the total foreign trade of nearly 315 million taels, Great Britain had over 215 millions, Japan 32 millions, Continental Europe (excluding Russia) 29 millions, the United States 20½ millions, and the Russian empire 17 millions. Nearly 219 million taels of this trade had its center in the port of Shanghai. The total number of foreign residents in China last year was 10,091, the British and Americans leading all other nations, with 4,084 and 1,325 respectively. Of the 603 foreign firms in the empire, 361 were British and 91 German.

AFRICA

UGANDA. About 100 miles of the new railway are expected to be constructed this year, at a cost of about £520,000. The total outlay will be not less than £3,000,000.

ASHANTI. Major Donovan, a British officer, recently visited lake Busumakwe and is said to be the first white man to have penetrated that region. The area of the lake was found to be about 48 square miles, and there is no apparent outlet.

DAHOMEY–LAGOS. The Anglo-French commission for the demarcation of the boundary between Dahomey and Lagos has completed its task to the satisfaction of all concerned. The French were found to have occupied several places in British territory and to have been receiving taxes therefrom, but the representatives of the French government promptly withdrew on this fact being established.

BRITISH CENTRAL AFRICA. Mr A. J. Swann, the British magistrate at Kotakota, lake Nyassa, who some time ago discovered some remarkable fresh-water medusæ, has recently found an immense bed of lime fossils

and flint, and the Royal Society of London has sent out an expedition to examine and report upon the latter discovery, with a view to throwing light on the origin of the great African lakes.

NORTH AMERICA

BRITISH AMERICA. The government of Newfoundland is issuing bonds for the construction and equipment of a railway from a point on the Exploits river about 200 miles from Placentia Junction to Port-aux-Basques.

AUSTRALASIA

AUSTRALIA. An expedition left Adelaide on May 22 to explore the interior of the island. Its return is not expected until late in 1897.

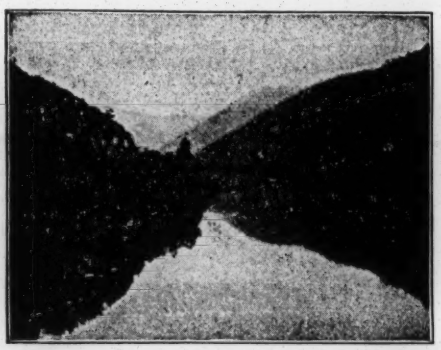
POLAR REGIONS

The steam-yacht *Windward* left London for Franz Josef Land on June 9 for the relief of the Jackson expedition. She carried a very large supply of provisions, a number of sledges, 5,000 tabloids of the essential properties of blood, and several thousand letters and packages. The *Windward* will call at Vardö to take on board coal, sheep, and reindeer, and she expects to communicate with the explorers at cape Flora, Franz Josef Land, on or about July 20. The return of the exploring party before 1897 is, however, very unlikely.

MISCELLANEA

THE SUEZ CANAL. The traffic through the Suez canal in 1895 comprised 3,434 ships, of 8,448,383 tons, with 216,938 passengers. Of the ships, 2,318 were British, 314 German, 278 French, 192 Dutch, 78 Italian, 72 Austrian, 57 Norwegian, 39 Russian, 36 Turkish, 33 Spanish, 5 American, 3 Portuguese, 2 Chinese, 2 Egyptian, 2 Japanese, 2 Swedish, and 1 Danish. Of the passengers, 118,639 were soldiers, 74,878 civilians, and 23,421 pilgrims and emigrants. The total receipts were 78,426,000 francs, an increase of 4,299,000 francs, gross, and of 3,172,000 francs, net, over those of 1894. The average duration of the transit was 16 hours 18 minutes, a reduction of 23 minutes from the average of the preceding year.

DEEP-SEA SOUNDINGS. The British Admiralty has just issued its report of the deep-sea soundings conducted by ships of the royal navy in 1895. Commander A. F. Balfour, in the *Penguin*, while surveying in the South Pacific, found very deep water to the eastward of a line drawn between the Friendly and Kermadec islands. Soundings of 5,147 and 5,155 fathoms were obtained in latitude 28° 44.4′ S., longitude 176° 04′ W., and latitude 30° 27.7′ S., longitude 176° 39′ W., respectively. The deepest sounding ever before obtained was 4,655 fathoms, to the northeast of Japan. The new soundings are therefore deeper by about 3,000 feet than anything before discovered. A remarkable fact in connection with the new soundings is that these extraordinary depths are not far from land.



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JANUARY.—Russia in Europe, with map, Hon. Gardiner G. Hubbard; The Arctic Cruise of the U. S. Revenue Cutter "Bear," with illustrations, Dr. Sheldon Jackson; The Scope and Value of Arctic Exploration, Gen. A. W. Greely, U. S. A.

FEBRUARY.—Venezuela: Her Government, People, and Boundary, with map and illustrations, William E. Curtis; The Panama Canal Route, with illustrations, Prof. Robert T. Hill; The Tehuantepec Ship Railway, with maps, E. L. Corthell, C. E., LL. D.; The Present State of the Nicaragua Canal, Gen. A. W. Greely; Explorations by the Bureau of American Ethnology, W J McGee. *Also map of the Orinoco valley, showing territory drained by that waterway and its bearing on the Venezuelan Boundary Question.*

MARCH.—The So-Called "Jeannette Relics," Prof. Wm. H. Dall; Nansen's Polar Expedition, Gen. A. W. Greely; The Submarine Cables of the World, Gustave Herrle; The Survey and Subdivision of Indian Territory, with map and illustration, Henry Gannett; "Free Burghs" in the United States, James H. Blodgett. *Also chart, 49 x 30 inches, showing Submarine Telegraph Cables of the World and Principal Land Lines. Full-page portraits of Dr. Nansen and Prof. Wm. H. Dall.*

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MAY.—Africa since 1888, with special reference to South Africa and Abyssinia, with map, Hon. Gardiner G. Hubbard; Fundamental Geographic Relation of the Three Americas, with map, Prof. Robert T. Hill; The Kansas River, Arthur P. Davis. *Also portrait of Hon. Gardiner G. Hubbard, President of the National Geographic Society.*

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